



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
| 10/611,395 | 06/30/2003 | Shriram Ramanathan | 42P16666 | 1525 |

8791 7590 06/01/2005

BLAKELY SOKOLOFF TAYLOR & ZAFMAN
12400 WILSHIRE BOULEVARD
SEVENTH FLOOR
LOS ANGELES, CA 90025-1030

| |
|----------|
| EXAMINER |
|----------|

BEREZNY, NEMA O

| | |
|----------|--------------|
| ART UNIT | PAPER NUMBER |
|----------|--------------|

2813

DATE MAILED: 06/01/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/611,395

Applicant(s)

RAMANATHAN ET AL.

Examiner

Nema O. Berezny

Art Unit

2813

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 15 March 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-42 is/are pending in the application.
- 4a) Of the above claim(s) 28-42 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-11 and 13-26 is/are rejected.
- 7) ☒ Claim(s) 12 and 27 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 30 June 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All. b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 3-15-05 has been entered. Claims 1-42 are currently pending, with claims 28-42 withdrawn.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-2, 5, 7, 13-14, 20, and 22 are rejected under 35 U.S.C. 102(b) as being anticipated by Kim (6,380,629). Kim discloses a method comprising: depositing a layer of a metal (Fig.3-4 el.31) on each of a number of conductors (el.11) disposed on a surface of a first wafer (el.10); aligning the first wafer with a second wafer (Fig.8), the second wafer (el.20) having a number of conductors (el.21) disposed on a surface (el.44) thereof; contacting (el.Fig.13 el.33) the metal layer on each of the conductors of

Art Unit: 2813

the first wafer with a mating one of the conductors on the second wafer (Fig.13); and forming a bond (el.33) between the metal layer on each of the conductors of the first wafer and the mating one conductor of the second wafer (Fig.13) **[claim 1]**.

Based upon the rejection of claim 1 above, Kim also discloses prior to depositing the metal layer on each of the conductors of the first wafer, removing dielectric material from the surface of the first wafer (col.4 lines 7-10) **[claim 2]**; wherein the metal comprises a metal selected from a group consisting of silver, gold, ruthenium, osmium, iridium, palladium, rhodium, and platinum (col.5 lines 58-60) **[claim 5]**; and wherein depositing the layer of metal on each of the conductors of the first wafer comprises: forming a blanket layer of the metal over the conductors and the surface of the first wafer; and removing the metal from at least portions of the first wafer surface (col.4 lines 11-15) **[claim 7]**.

Kim also discloses a method comprising: depositing a layer of a first metal (Fig.3-4 el.31) on each of a number of conductors (el.11) disposed on a first wafer (el.10); depositing a layer of a second metal (el.32) on each of a number of conductors (el.21) disposed on a second wafer (el.20); aligning the first wafer with the second wafer (Fig.8); contacting (Fig.13 el.33) the metal layer on each of the conductors of the first wafer with the metal layer on a mating one of the conductors of the second wafer (Fig.13); and forming a bond (el.33) between the metal layer on each of the conductors of the first wafer and the metal layer on the mating one conductor of the second wafer (Fig.13; col.4 lines 1-15, 39-41) **[claim 13]**.

Based upon the rejection of claim 13 above, Kim also discloses prior to depositing the metal layer on each of the conductors of at least one of the first and second wafers, removing dielectric material from a surface of the at least one wafer (col.4 lines 7-10) **[claim 14]**; wherein the first metal and the second metal are the same (col.5 lines 58-60) **[claim 18]**; wherein each of the first and second metals comprises a metal selected from a group consisting of silver, gold, ruthenium, osmium, iridium, palladium, rhodium, and platinum (col.5 lines 58-60) **[claim 20]**; and wherein depositing the metal layer on each of the conductors of at least one of the first and second wafers comprises: forming a blanket metal layer over the conductors and a surface of the wafer; and removing the blanket metal layer from at least portions of the wafer surface (col.4 lines 11-15) **[claim 22]**.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 3-4, 6, 15, and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kim as applied to claims 1 and 13 above, and further in view of Shih et al. (6,329,722). Kim does not disclose removing native oxide from the conductors, conductors comprising copper, or bonding at a temperature of 100-300 degrees C.

However, Kim would look to one such as Shih for lower resistance, a stronger solderable surface, and lower oxidation of metallic surfaces, respectively.

Shih discloses prior to depositing the metal layer on each of the conductors of at least one of the first and second wafers, removing native oxide from the conductors (col.3 lines 1-6). Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to use the native oxide removal of Shih with the method of Kim in order to provide lower resistance and therefore a better mechanical bond (an inherent property of native oxide increases resistance) **[claims 3, 15]**.

Shih also discloses wherein the conductors of the first wafer comprise copper (col.2 line 65 - col.3 line 1). Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to use the copper conductors of Shih with the method of Kim in order to provide a strong solderable surface (Shih - col.2 lines 28-31) **[claim 4]**.

Shih also discloses wherein the bond is formed at a temperature between approximately 100 and 300 degrees Celsius (col.5 lines 49-53). Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to use the bonding temperature of Shih with the method of Kim in order to provide less oxidation of the metallic surfaces at a lower temperature (Shih - col.5 lines 59-63) **[claims 6, 21]**.

Claims 8-11, 16-17, and 23-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kim as applied to claims 1 and 13 above, and further in view of

Art Unit: 2813

Neuhaus et al. (200210027294). Kim does not disclose selectively depositing a metal on the conductors comprising a number of islands, or the conductors of the first and second wafers comprising the same metal or comprising copper. However, Kim would look to one such as Neuhaus for reduction of fabrication steps, a better electrical and mechanical bond, and conductors with higher conductivity. Neuhaus discloses wherein depositing the layer of metal on each of the conductors of at least one of the first and second wafers comprises selectively depositing the metal on each of the conductors using an electroless plating process, an electroplating process, or a contact displacement plating process (p.4 para.38). Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to use the depositing of Neuhaus with the method of Kim in order to eliminate the fabrication steps of patterning, etching, and removing of material which is required for conventional deposition and patterning of conductors **[claims 8, 9, 23, 24]**.

Neuhaus discloses wherein the metal layer on each of the conductors of at least one of the first and second wafers comprises a number of islands which are selectively deposited on each of the conductors (p.4 para.50; p.6 para.64). Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to use the metal layer island deposition of Neuhaus with the method of Kim in order to pierce the conductors and form a stronger bond (Neuhaus - p.5 para.57) **[claims 10, 11, 25, 26]**.

Neuhaus discloses wherein the conductors of each of the first and second wafers comprise the same metal (p.4 para.51). Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to use the same metal for conductors of the first and second wafers of Neuhaus with the method of Kim in order to perform the same fabrication step of conductor deposition for both wafers **[claim 16]**.

Neuhaus discloses wherein the conductors of each of the first and second wafers comprise copper (p.3 para.28). Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to use copper metal for conductors of the first and second wafers of Neuhaus with the method of Kim in order to provide conductors of high conductivity (inherent property of copper) **[claim 17]**.

Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kim as applied to claim 13 above, and further in view of DiStefano (6,324,754). Kim does not disclose the first and second metals being different. However, Kim would look to one

Art Unit: 2813

such as DiStefano for centering solder balls because DiStefano discloses wherein the first metal and the second metal are different (col.6 lines 51-64; co1.10 lines 66-67).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to use different metals for the first and second metals of Neuhaus with the method of Kim in order to provide centering of the solder balls upon the first and second metals (co1.10 lines 66-67).

Allowable Subject Matter

The following is a statement of reasons for the indication of allowable subject matter, regarding claims 12 and 27: the prior art of record does not teach or disclose or make obvious depositing a blanket layer of metal over conductors and the surface of the wafers, and removing said metal layer from the wafer surface and from portions of each conductor to form a number of islands on each conductor. Neuhaus discloses forming conductive particles or islands to conductors, but not by a subtractive method (p.4 para.38, 50; p.6 para.64).

Claims 12 and 27 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nema O. Berezny whose telephone number is (571) 272-1686. The examiner can normally be reached on M-F 9-5:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr. can be reached on (571) 272-1702. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only.

For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

NB


CARL WHITEHEAD, JR.
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800